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REVISION OF THE GENUS *RUBIA* L. IN INDIA AND ADJOINING REGIONS

D. B. DEB AND K. C. MALICK
Botanical Survey of India, Calcutta

ABSTRACT

The present revision of the genus *Rubia* L. (Rubiaceae) is based on the specimens located in Indian herbaria. The area under consideration covers India, Sikkim, Bhutan, Nepal, Burma, Pakistan and Afghanistan, the latter three being represented only partially. 13 taxa in 9 species 2 varieties and 2 forms are treated in detail. One species *R. aitchisonii* Deb et Malick and one form *R. cordifolia* L. var. *cordifolia* f. *strigosa* Deb et Malick are added to science, while the status of *R. infundibularis* Hemsl. & Lace is reduced to *R. albicaulis* Boiss. var. *stenophylla* Boiss. f. *infundibularis* (Hemsl. & Lace) Deb et Malick. Lectotypes of 5 taxa and neotype of one taxon are designated. A key to the species is presented. In the present study the species described are grouped in two sections distinguished by the pinnate and palmate venations of the leaf. The form of the leaf and presence or absence of petiole are considered as taxonomic characters in subdividing the sections.

INTRODUCTION

Rubia L. is the type genus of the family Rubiaceae. This is closely allied to *Asperula* L. and *Calium* L. with which it is placed along with others in the tribe Rubieae. In Sp. Pl. Linne described 2 species, namely *R. tinctorum* L. and *R. peregrina* L. The only systematic treatment of the genus as a whole is that in DC. Prodr. 4: 588. 1830. Since then, there has been no detailed systematic account of the genus as a whole, although accounts of the group on a small scale have appeared in recent times in several local floras (*Kitamura,* 1955 ; *Koie & Rechinger,* 1958).

There are about 80 spp. known in the genus distributed throughout the world in the tropical and temperate regions. In Asia this is spread from India to China and Japan, Java and to Persia, Turkestan and Arabia.

The present revision is based on specimens of *Rubia* L. located in Indian herbaria. The area under consideration covers the Indian region, that is to say India proper and Sikkim, Bhutan, Nepal, Burma, Pakistan and Afghanistan, the latter three being represented partially. Hook. f. (1881) described 8 spp. in the Flora of British India as occurring in the area concerned. In the present study 13 taxa in 10 spp., 1 var. and 2 forms are described. Of these 1 sp. and 1 form are added to science while one species recognized so far, is reduced to the status of a form.

TAXONOMIC CHARACTERS

De Candolle (1830), G. Don (1834) and Schumann (1891) laid stress on the habit of the plant and the number of segments of the floral whorls for subdividing the genus above specific rank. From our study of the genus we find that venation of the leaf bears greater taxonomic significance above specific level. At the specific and lower levels the form of the leaf and the presence or absence of petiole etc. are significant. Number of floral parts is of no taxonomic importance.

THE GENUS ABOVE SPECIFIC RANK

De Candolle and G. Don subdivided the genus into 3 sections, (1) *Exinvolucratae,* (2) *Involucratae* and (3) *Galioideae,* of which the first one is distributed throughout the world while the other two are American. Exinvolucratae which are represented in the area under consideration were divided into 3 subsections *i.e.,* (1) *Cordifoliae,* (2) *Suffruticosae* and (3) *Tinctoriae.* Schumann in Engler & Prantl, Pflanzenfam. 4 (4): 153. 1891, divided the genus into 3 sections namely (1) *Cordifoliae,* (2) *Tinctoriae* and (3) *Angustifoliae.*

In the present work the species described have been grouped in two sections distinguished by the pinnate or palmate venation of the leaf.

Rubia Sect. **Rubia**

Exinvolucratae DC. subsect. *Tinctoriae* DC. Prodr. 4: 589. 1830; G. Don, Gen. Syst. 3: 643. 1834; *Tinctoriae* K. Schum. in Engl. & Prantl, Pflanzenfam. 4(4): 153. 1891.

Number of species 6 only in the region.

Type : *R. tinctorum* L. Leaves pinnately veined.

Rubia Sect. **Cordifoliae** (DC.) K. Schum. in Engl. & Prantl, Pflanzenfam. 4(4): 153. 1891.

Exinvolucratae DC. subsect. *Cordifoliae* DC. Prodr. 4: 588. 1830; G. Don. Gen. Syst. 3: 642. 1834.

Number of species 4 only in the region.

Type: *R. cordifolia* L. Leaves palmately veined.

HERBARIA CONSULTED

Specimens of the herbaria named below have been examined; symbols recognized in the *Index Herbariorum* have been used. For others symbols used are noted below.

Name of the Herbarium	Symbols used
1. Central National Herbarium	CAL
2. Eastern Circle, B.S.I. Shillong	ASSAM
3. Northern Circle, B.S.I., Dehra Dun	BSD
4. Western Circle, B.S.I., Poona	BSI
5. Southern Circle, B.S.I., Coimbatore	MH
6. Forest Research Institute, Dehra Dun	DD
7. Regional Research Laboratory, Jammu	JAMMU
8. National Botanic Garden, Lucknow	LWG
9. Blatter Herbarium, Bombay	BLAT
10. Industrial Section, Indian Museum, Calcutta	I.S.I.M.
11. Calcutta University, Calcutta	CALC UNIV

Rubia L. Sp. Pl. 109. 1753, Gen. Pl. ed. 5: 47. 1754 et Mant. Pl. 197. 1767; Jussieu, Gen. Pl. 197. 1789; Roxb. Fl. Ind. 1:383. 1820 et 1:374. 1832; DC. Prodr. 4: 588. 1830; Wt. & Arn. Prodr. 1: 442. 1834; G. Don, Gen. Syst. 3: 642. 1834; Royle, Ill. 237. 1839; Dalz. & Gibs. Bomb. Fl. 121. 1861; Kurz in Journ. Roy. Asiat. Soc. Beng. 43 (2): 188. 1874 et 46 (2): 162. 1877; Hook. f. Fl. Brit. Ind. 3: 202. 1881; Schum. in Engl. & Prantl, Pflanzenfam. 4 (4): 153. 1891; Prain, Beng. Pl. 580. 1903; Cooke, Fl. Pres. Bomb. 1: 625. 1903; Duthie, Fl. Upp. Gang. Pl. 430. 1903; Bamb. Pl. Punj. 578. 1916; Gamble, Fl. Pres. Madr. 4: 654. 1921; Haines, Bot. Bih. Or. 4: 452. 1922; Kanj. et al. Fl. Assam 3: 94. 1939; Mooney, Suppl. Bot. Bih. Or. 73. 1950; Kitam. in Kihara, Faun. Fl. Nep. Himal. 1: 231. 1955, Fl. Afgh. 369. 1960 et Fl. West Pakist. 137. 1964; Sant., Fl. Purand. 63. 1957; Koie & Reching. in Symb. Afgh. 4: 134. 1958. *Rubina* O. Ktze. Rev. Gen. Pl. 1:296. 1891.

Scabrid, hispid or prickly, climbing or erect herb or undershrub. *Leaves* 4-10 in whorl, rarely 2-opposite, long petioled to sessile, stipule modified to leaves or absent. *Flowers* in axillary and terminal panicle of cymes. *Calyx* completely enclosing the ovary and adherent to it, lobes absent. *Corolla* gamopetalous, rotate or shortly bell-shaped. *Stamens* generally 5, rarely 4 or 6, epipetalous, anthers oblong, sometimes reniform. Disk annular, around the basal portion of the style. *Pistil* bicarpellary, syncarpous. *Styles* 2, united partly. *Ovary* inferior, 2-celled, ovule one in each cell, attached to the base of the septum. *Fruit* globose by suppression of one carpel or didymous. *Seed* suberect, albuminous. *Embryo* with two leafy cotyledons and one straight axis.

Type: *Rubia tinctorum* L. Sp. Pl. 109. 1753.

KEY TO THE SPECIES

1. Leaves pinnately veined, short-petioled or sessile :
    2. Petiolate :
        3. Lamina elliptic-ovate or obovate ... *himalayensis*
        3′ Lamina elliptic or elliptic-lanceolate... *tinctorum*
    2′ Sessile :
        4. Lamina ovate, sub-orbicular, elliptic-ovate or lanceolate, 2-6 in a whorl ... ... *tibetica*
        4′ Lamina elliptic-lanceolate, 2 opposite *aitchisonii*
        4″ Lamina linear subfalcate ... *florida*
        4‴ Lamina narrowly linear ... ... *angustissima*

1′ Leaves palmately veined, petiolate or sessile :
    5. Petiole present :
        6. Petiole long (5-8 cm) ... *cordifolia*
        6′ Petiole short (.4-.5 cm) ... *edgeworthii*
    5′ Petiole absent :
        7. Lamina elliptic or elliptic-lanceolate ... ... *sikkimensis*
        7′ Lamina linear or linear-lanceolate *albicaulis* var. *stenophylla*

R. himalayensis Klotzsch in Klotzsch & Garcke, Bot. Erg. Reise Prinz. Wald. Preuss. 86, t 76. 1862; Hook. f. Fl. Brit. Ind. 3: 203. 1881; Koie & Reching. in Symb. Afgh. 4: 140. 1958 (Fig. 1).

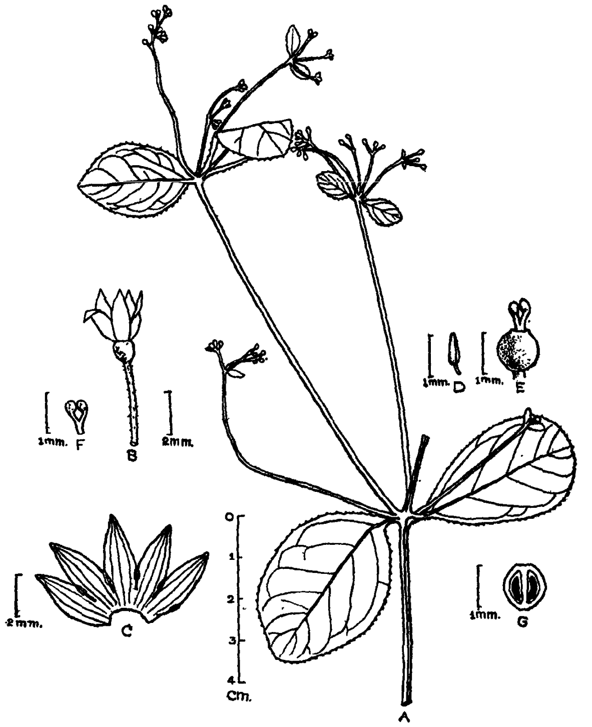

Fig. 1. *Rubia himalayensis* Kl. (*Stoliczka* s.n.)
A. Habit. B. Flower. C. Corolla showing the position of stamens. D. Stamens. E. Pistil. F. Style and stigma. G. Ovary in L.S.

Climbing *herb*; branches long, slender, stem quadrangular, angles rounded, prickly, surface rough or finely prickly. *Leaves* simple, membranous, 2-4 in whorl, when 4 one pair larger than the other, 2-6.6 × 1.1-2.7 cm elliptic-ovate or obovate, unicostate, rounded, subacute or apiculate at the apex, margin prickly on the undersurface, lateral nerves obscure; petiole short, 3-9 mm. *Inflorescence* axillary and terminal panicle of cymes. *Peduncles* long. *Flowers* bracteate, pedicellate, 3-4 × 3-3.5 mm; bracts in pair, sessile, foliaceous, opposite, 5-7 × 2-4 mm, ovate-elliptic, margins prickly. *Calyx* globose, enclosing the ovary and adherent to it, lobes absent. *Corolla* gamopetalous, 2.5-3 mm long, lobes 5, oblong, acute or apiculate at the apex. *Stamens* 5, epipetalous, alternating the petals, free portion of the filament .5 mm long, anthers at the throat of the corolla, .75-1 mm long, oblong, 2-lobed, dorsifixed. Disk annular, thin around the basal portion of the style. *Pistil* bicarpellary, syncarpous; stigma globose, sometimes unequal; style 2, sometimes unequal, .5-.75 mm long, united more than half the length; ovary ovoid, .75-1 × .75-1 mm, 2-celled ovule one in each cell, attached to the base of the septum. *Fruit* 4-5 mm, globose by suppression of one carpel or didymous. *Seeds* curved, albuminous; *embryo* with two large cotyledons and one straight axis.

Flowering time: June. *Fruiting time:* September.

Distribution: Western Himalayas, Kunwar, Kashmir, West Pakistan, Afghanistan.

Type: Klotzsch *s.n.* located at Berlin-Dahlem (B) was destroyed during the last world war (*Sleumer* 1949). Hence *pl.* 76 in Klotzsch et Garcke, Bot. Erg. Reise Prinz. Wald. Preuss. (*l.c.*) is designated here as the lectotype.

Herbarium specimens examined: Himachal Pradesh: Bashahr, *Lace* 573 (I.S.I.M). N. W. Himalayas: Pangee, *Stoliczka* s.n. (CAL); Rispi, *Brandis* 3442 (CAL & DD); Rogee, Kunwar,? 97/14 (DD). West Pakistan: Loralai, *Harsukh* 18859 (CAL). Afghanistan: Kabul, ? s.n. (CAL), Afghanistan, *Griffith* 3068 (CAL).

R. tinctorum L. Sp. Pl. 109. 1753; DC. Prodr. 4: 589. 1830; Hook. f. Fl. Brit. Ind. 3: 203. 1881; Kitam. Fl. Afgh. 370. 1960 (Fig. 2).

Climbing *herb*; branches long, numerous, divaricate; stem quadrangular, angles sharp, prickly or scabrid, surface glabrous. *Leaves* simple, subsessile, 4-6 in whorl, 4-10 × .5-3.5 cm, usually elliptic, sometimes elliptic-lanceolate, glabrous, margin denticulate, acute at the apex, attenuated at the base, unicostate, midrib prickly on the undersurface; petiole 2-3 mm long. *Inflorescence* terminal and axillary panicle of cymes, spreading; peduncles long, quadrangular, angles prickly. *Flowers* bracteate, pedicelled, minute, 3-3.5 × 2-3 mm, pedicels 1.5-2 mm long, quadrangular; bracts 2, opposite, foliaceous, sessile, margins prickly; elliptic or lanceolate, acute at the apex. *Calyx* globose, enclosing the ovary and adherent to it, lobes absent. *Corolla* gamopetalous, 2-2.5 mm long, lobes lanceolate, shortly acuminate at the apex. *Stamens* 5, epipetalous, alternating the petals; free portion of the filament very short, shorter than the anthers; anthers at the throat of the corolla, .5 mm long, 2-lobed, dorsifixed, dehiscing longitudinally. Disk annular, around the base of the style. *Pistil* bicarpellary, syncarpous; stigma globose; style 2, united at the base, .5-.75 mm long; ovary .75-1 × .75-1 mm, 2-celled, ovule one in each cell, attached to the base of the septum. *Fruit* 3.5-4 × 4-4.5 mm, globose by suppression of one carpel

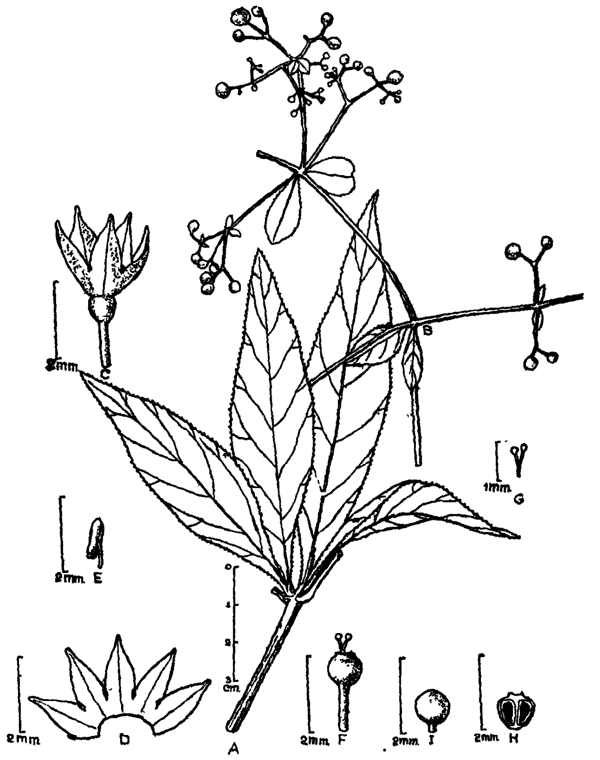

Fig. 2. *Rubia tinctorum* L.
A&B. Habit. C. Flower. D. Corolla showing position of the stamens. E. Stamen. F. Pistil. G. Style and stigma. H. Ovary in L.S. I. Fruit. (A. *Scully* 26, B-I. *Lace* s.n.)

or didymous; *embryo* with two leafy cotyledons and one straight axis.

Flowering time: June. *Fruiting time:* July.

Distribution: From Kashmir westwards to Spain through S. Europe.

Herbarium specimens examined: Afghanistan, *Griffith* 3067 (CAL), *Aitchison* 255 (DD), ? 749 (CAL). West Pakistan: Baluchistan, *Gust. Pers.* 7619 (BLAT), ? s.n. (CAL); Hanna valley, *Lace* s.n. (DD & CAL). Turkistan: E. Turkistan, *Sculley* 26 (CAL); Zarkand, *Sculley* 32 (CAL).

R. tibetica Hook. f. Fl. Brit. Ind. 3 : 204. 1881; Koie & Reching. in Symb. Afgh. 4 : 139. 1958; Kitam. in Fl. Afgh. 370. 1960 et West Pak. 137. 1964 (Fig. 3).

Erect *herb,* short, scabrid; branches short; stem quadrangular, angles rounded, scabrid, surface rough; nodes at the stems below shortly sheathed with membranous bases of old leaves. *Leaves* simple, sessile, 2-6 at each node, 1.5-2.3 × .5-1 cm, ovate, suborbicular, elliptic-ovate or lanceolate, coriaceous, scabrid at the margin and midrib below, acute at the apex, unicostate, nerves obscure. *Inflorescence* in axillary or terminal cymes or solitary flowered; peduncles long, more or less scabrid. *Flowers* rather large in size, 3.5-4 × 2.5-3 mm, bracteate, pedicellate; bracts 2, lanceolate, pedicels 4-6 mm long, quadrangular, pubescent. *Calyx* globose, enclosing the ovary and adherent to it, pubescent, lobes absent. *Corolla* gamopetalous, 3-3.5 mm long, pubescent, tube very short, .75 mm long, lobes 5, ovate-lanceolate, acuminate at the apex. *Stamens* 5, epipetalous, alternating the petals, free portion of filaments .75-1 mm, anthers at the throat of the corolla, .5-.75 mm, reniform, 2-lobed, dorsifixed. Disk annular, around the basal portion of the style. *Pistil* bicarpellary, syncarpous; stigma globose; styles 2, united at the base, .5-.75 mm long; ovary .75-1 × 1-1.25 mm, 2-celled, ovule one in each cell, attached to the base of the septum. *Seeds* suberect, albuminous; *embryo* with two leafy cotyledons and one straight axis.

Flowering time: June-August.

Distribution: India-Punjab (Spiti), Kashmir (Ladak) Kulu; Karakoram, Tibet, Afghanistan, Pakistan.

Type: Western Tibet, 3000-4000 m, *Thomson* s.n. in the herbarium (CAL) is designated here as the lectotype.

Herbarium specimens examined: Punjab: Spiti-Sungnum, *Stoliczka* s.n. (CAL); Kunzan pass, *Kaushek* 957 (DD); Kaza, *Gill* 2013 (DD). Kashmir: Chakar Taloo, Ladak, *Urusvati Himalayan Research Institute, Roerich Museum* 2469 (DD). Tibet: Western Tibet, *Thomson* s.n. (CAL); Transtse Sumdo and Lapurba in Karnag, *Stoliczka* s.n. (CAL).

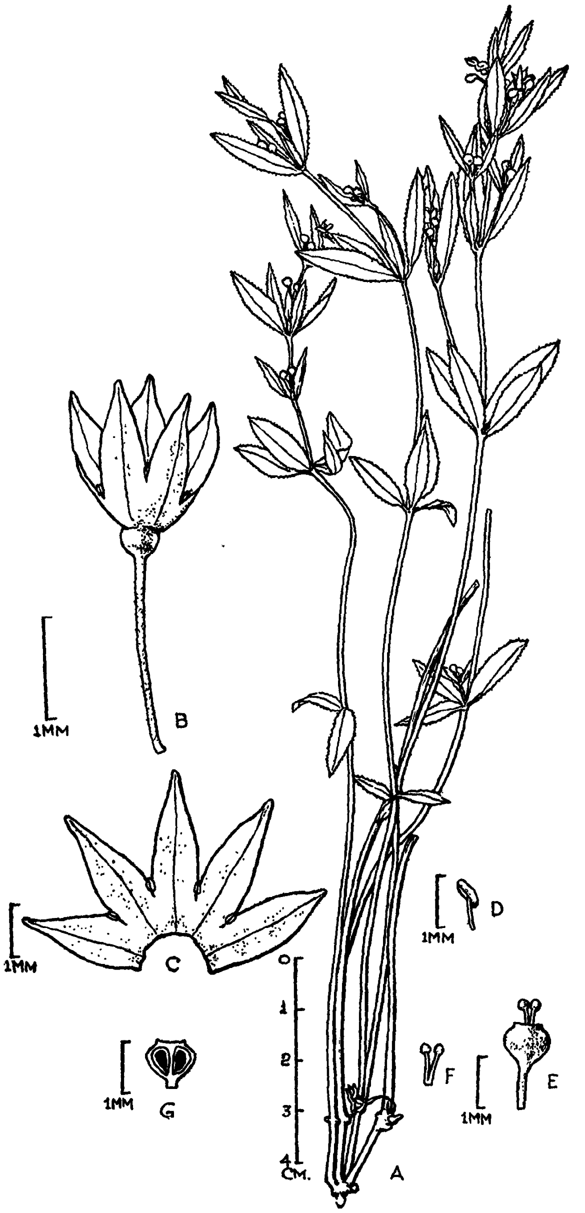

Fig. 3. *Rubia tibetica* Hook. f.
A. habit (*Stoliczka* s.n.). B. Flower. C. Corolla showing position of stamens. D. Stamen. E. Pistil. F. Style and stigma. G. Ovary in L.S.

R. aitchisonii Deb et Malick in Journ. Bomb. Nat. Hist. Soc. 63(3): 781. 1966.

Undershrub 6-9 dm in height, much branched; branches short, lower part of the stem woody, terete, bark scaly, young parts quadrangular; internodes very short. *Leaves* simple, 2.4-2.7 × 0.25-0.5, sessile, elliptic-lanceolate, coriaceous, closely prickled at the margins, acute at the apex, attenuated at the base, pinnately nerved, nerves 4-5, obscure, prickly. *Inflorescence* axillary and terminal cymes; peduncles long, quadrangular, prickly. *Flowers* greenish-yellow, 5-6 × 3-3.5 mm, pedicels 0.6-1 cm long, quadrangular, thinly prickly. *Calyx* completely enclosing the ovary and adherent to it, prickly. *Corolla* gamopetalous, 4-5 mm long, lobes 5 or 6 oblong or oblong-lanceolate, mucronate at the apex. *Stamens* 5 or 6, epipetalous, alternating the petals, free portion of the filaments 0.25-0.5 mm long, anthers 0.5-0.75 mm long; oblong, bilobed, dorsifixed. Disk annular, thin, around the basal portion of the style. *Pistil* bicarpellary, syncarpous: styles 2, 0.75-1 mm long, united; stigma globose; ovary 1.25-1.5 × 1.5-1.75 mm 2-celled, ovule one in each cell, attached to the base of the septum.

Flowering time: April-May.

Type: J. E. T. Aitchison 338 A collected from Badgis, Afghanistan, on 29 April 1885 is preserved in Central National Herbarium (CAL); paratype, *J. E. T. Aitchison 338 B* collected from the same place on 20 May 1885 is located in the herbarium, Forest Research Institute (DD).

R. florida Boiss. [in Kotsch Pl. Pers. Exs. Febr. 1845 &] Diagn. Pl. Or. Nov. 1(6): 70. 1845; Ait. in Trans. Linn. Soc. ser. ii. 73. 1888; Koie & Reching. in Symb. Afgh. 138. 1960.

Undershrub 6 dm in height; lower part woody; branches long, stout; stem whitish, glabrous, with scaly bark, almost quadrangular. *Leaves* simple, sessile, 2 opposite, 1.5-1.75 × .15-.2 cm, subfalcate, linear, coriaceous, entire at the margin, acute at the apex, base attenuated. *Inflorescence* axillary and terminal cymes; peduncles quadrangular, thinly prickly. *Flowers* minute, 3-3.5 × 2.5-3 mm; pedicels 2-2.5 mm long, quadrangular, thinly prickly. *Calyx* enclosing the ovary and adherent to it, lobes absent. *Corolla* gamopetalous, 3-3.5 mm long, tube short, lobes 5, oblong-lanceolate, mucronate at the apex. *Stamens* 5, epipetalous, alternating the petals, free portion of the filament .5-.75 mm long, anthers at the throat of the corolla, oblong, reniform, dorsifixed. Disk annular thin around the basal region of the style. *Pistil* bicarpellary, syncarpous, styles 2, .5-.75 mm long; stigma globose; ovary .5-.75 × .5-.75 mm, 2-celled, one ovule in each cell, attached to the base of the septum.

Flowering time: April.

Distribution: Afghanistan, Persia, Iran.

Type: Kotschy 245 located in the herbarium (CAL) is designated here as the lectotype.

R. angustissima Wall. ex G. Don, Gen. Syst. 3: 643. 1834; Kurz in Journ. Roy. As. Soc. Beng. 46(2): 162. 1877; Hook. f. Fl. Brit. Ind. 3:203. 1881; Haines, Bot. Bih. Or. 4: 453. 1922 (Fig. 4); *R. charaefolia* Wall. ex G. Don, Gen. Syst. 3:643. 1834.

Climbing *herb,* shining; branches long; stem quadrangular; angles winged, scabrid; surface smooth, shining. *Leaves* simple, sessile, 4-10 in whorl, 10-14 × .15-.3 cm, keeled, young filiform, thin and brittle, flat above, unicostate, midrib strong beneath, shining, smooth or sparingly scabrid, very narrowly linear, acute at the apex. *Inflorescence* axillary and terminal cymes, sometimes solitary flowered; pedicellate, minute, 2-2.5 × 2-2.25 mm; bracts foliaceous, 2 or more, sessile, .3-1 cm, linear, margins prickly, acute at the apex; pedicels .25-1.5 cm long, quadrangular, prickly or smooth. *Calyx* cup-shaped, enclosing the ovary and adherent to it, lobes absent. *Corolla* gamopetalous, 1.5-1.75 mm long, lobes 5, ovate-lanceolate, acute or acuminate at the apex. *Stamens* 5, epipetalous, alternating the petals, free portion of the filament .5 mm long, anther .5 mm long, oblong or ellipsoid, dorsifixed. Disk annular, much raised around the base of the style. *Pistil* bicarpellary, syncarpous; stigma globose; styles 2, united up to half the length or less; .5-.75 mm long; ovary .5-.75 × .5-.75 mm, cup-shaped, 2-celled, ovule one in each cell, attached to the base of the septum. *Fruits* 3.5-4 × 3-3.5 mm, globose by suppression of one carpel or didymous. *Seeds* suberect; *embryo* with two leafy cotyledons and one straight axis.

Flowering time: October-November. *Fruiting time:* November-December.

Distribution: India-West Bengal, Bihar, Uttar Pradesh, Kashmir; Sikkim, Nepal and Burma.

Type: Taong Dong, 26.11.1826, *Wall. Cat.* 6207 located in the herbarium (CAL) is designated here as the lectotype.

Note: Airy-Shaw in Kew Bull. 1931: 451. 1931 distinguished *R. charaefolia* Wall. ex G. Don from *R. angustissima* Wall. ex G. Don.

Following Kurz (l.c.) and Hook. f. (l.c.) we do not consider the distinction tenable.

Herbarium specimens examined: West Bengal: Rilli forest, Darjeeling, *Gamble* 243 B.E. (CAL); Ruman, *Clarke* 24918 (CAL). Bihar: Sameshwar hill, *Srivastava* 48482 (LWG). Uttar Pradesh: Almora, *Awasthi* 1996 (LWG). Kashmir: Baramullah, *Singh* 11309 & 11367 (LWG). Burma: Taong Dong, 13.11.1826, *Wall. Cat.* 6207, 26.11. 1826, *Wall. Cat.* 775 (CAL) Maymyo plateau, *Lace* 5495 (CAL & DD); Minbu, *Arbert & Gage* s.n. (CAL); Kaupetlet, *Maung Gale* 5600 (DD). Nepal: 1821, *Wall. Cat.* 6210 (CAL). Sikkim: Rishi to Rinchingpong, *Anderson* 679 (CAL); Sikkim, *King* 222 (CAL); Siriong, *Clarke* 13182 A (CAL); Sikkim, *Gammie* 'Mark D' (DD); Teesta, *Clarke* 10124 B (CAL); Tropical Valleys, *Kurz* s.n. (CAL).

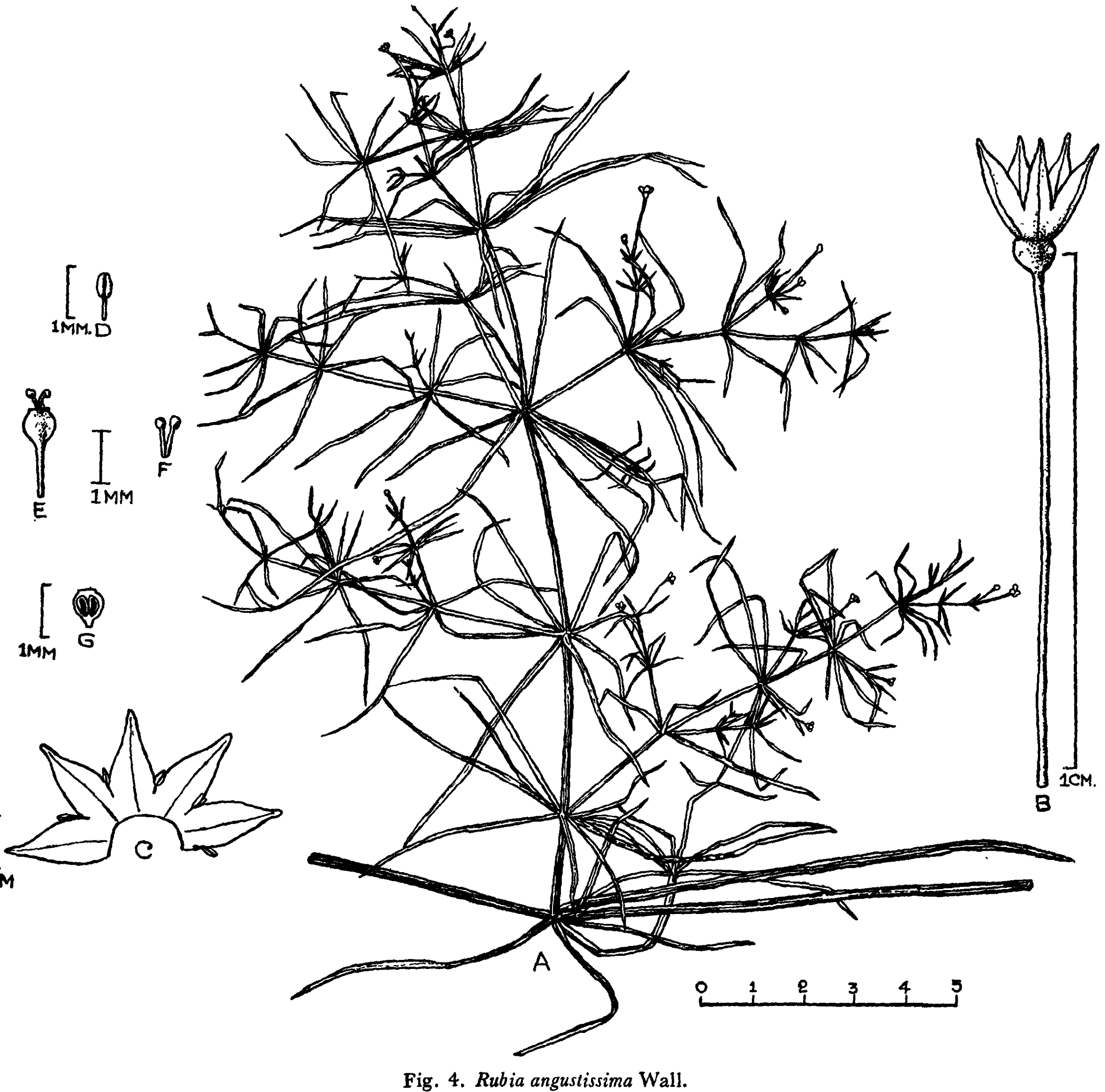

Fig. 4. *Rubia angustissima* Wall.
A. Habit (*Stoliczka* s.n.). B. Flower. C. Corolla showing position of stamens. D. Stamen. E. Pistil. F. Style and stigma. G. Ovary in L. S.

R. cordifolia L. Mant. 197. 1767; Hook. f. Fl. Brit. Ind. 3: 202. 1881. *R. manjith* Roxb. ex Fleming in Asiat. Res. 11: 177. 1810; Hara & Kurosawa in Sci. Rep. Tohoku Univ. Ser. 4 (Biol), 29: 259. 1963. *R. munjista* Roxb. Fl. Ind. 1: 384.

1820 et 1:374. 1832; DC. Prodr. 4:588. 1830. *R. scandens* Zoll. et Mor. Miq. Fl. Ind. Bat. 2:338. 1856. *R. mitis* Miq. in Ann. Mus. Lugd. Bat. 3: 112. 1867. *R. cordifolia* L. var. *munjista* Miq. Ann. Mus. Lugd. Bat. 3: 111. 1867; Kitam. in Kihara Faun. and Fl. Nepal Himal. 1: 231. 1955 (Fig. 5).

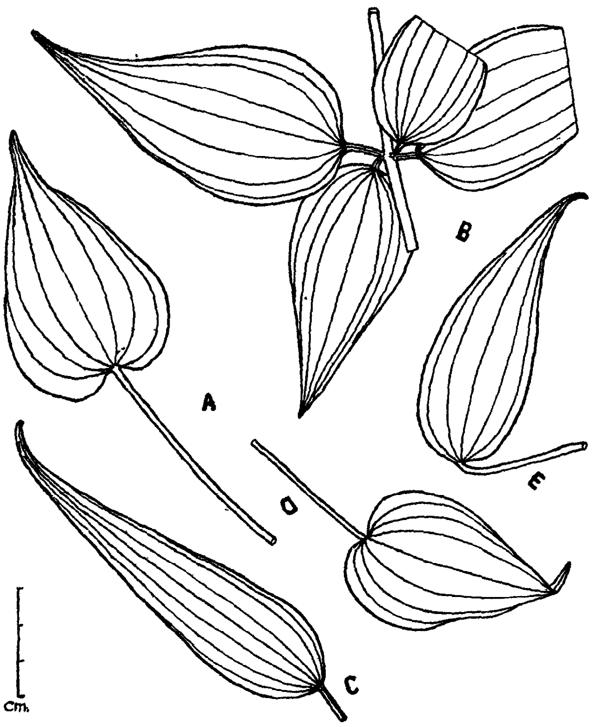

Fig. 5. *Rubia cordifolia* L. var. *cordifolia* (A-C) & var. *khasiana* Watt (D & E) showing variation in the form of leaf.
A. (*Anderson* 683). B. (*Narayanswami* 652). C. (*Chandra* & *Party* 36430—LWG). D. (*J.D.H.* s.n.). E. (*King* s.n.)

Climbing *herb*, root stock perennial; branches long, numerous divaricate; stem with long internodes, quadrangular, sharply angled, sometimes prickly or hispid, often glabrous. *Leaves* simple, 2-8 in whorl, normally 4, sometimes one pair larger than the other, 1.2-9.3 × 3-5 cm, veins 3-9 palmate, impressed or raised on the upper surface, cordate at the base, sometimes rounded, particularly at the apical portion of the branch, entire at the margin, acute or acuminate at the apex, surface smooth or retrorsely scabrid or hairy or strigose, petiole usually long, 5-8 cm, sometimes as short as .5 cm, prickly or smooth, sometimes hispid; stipules absent or modified to leaves. *Inflorescence* axillary and terminal panicle of cymes, trichotomously branching, many to few flowered, peduncle long, quadrangular, scabrid or smooth. *Flowers* 3.5-4.5 mm, regular, bisexual, epigynous, bracteate, pedicelled; bracts in pair, variable in size, opposite, sessile, ovate, acute; pedicels 3-4.5 mm long, quadrangular, scabrid or smooth. *Calyx* globose, enclosing the ovary and adherent to it, lobes absent. *Corolla* gamopetalous, greenish, white, pinkish light yellow, brownish yellow or purple red or orange, 3-3.5 × 1-1.5 mm, lobes 5, sometimes 4, lanceolate, acute. *Stamens* 5, epipetalous, free portion of the filament .5-.75 mm long, anthers at the throat of the corolla, oblong, 2-celled, longitudinally dehiscent, basifixed. Disk annular, thin. *Pistil* bicarpellary, syncarpous; stigma globose; styles 2, united at the base .5-.75 mm long; ovary .5-1 × .5-.75 mm, 2-celled, ovule one in each cell, attached to the base of the septum. *Fruits* 4-5 × 3.5-5 mm, globose by suppression of one carpel or didymous. *Seeds* suberect, albuminous; *embryo* with two leafy cotyledons and one straight axis.

Flowering time: February-December. *Fruiting time:* March-January.

Distribution: India, Burma, Bhutan, Sikkim, Nepal, Tibet, Pakistan, Afghanistan, Indochina, Java, Japan, Korea, Ceylon, Malacca, China, U.S.S.R., N.E. Asia, Trop. Africa.

Note: There exists a difference of opinion regarding the correct identity of *R. munjista* Roxb. Fl. Ind. 1: 383. 1820. Roxburgh while describing *R. munjista* observed that it differs from *R. cordifolia* L. in being pentamerous. Linne described the flowers of *R. cordifolia* as tetramerous, while Lamarck, Encycle. Meth. 2: 606. 1790 described the flowers being 4 or 5 cleft. Wallich in a footnote to *R. munjista* Roxb. (loc. cit.) strongly suspected that it is same as *R. cordifolia* L. and in support of his contention he quoted Lamarck's observation cited above. He further added "In the numerous specimens which have been sent to me by Mr. Gardner from Gossain—Than and Katmandu, and by Sir Robert Colquhoun from Almora, I have found the flowers always pentamerous". Wight (l.c.) and Hook. f. (l.c.) treated *R. munjista* as synonym of *R. cordifolia* and described the flowers usually 5 or sometimes 4 cleft. Recently Kitamura in Kihara, Fauna Fl. Nep. Him. 231. 1955, probably following Miquel (l.c.) treated *Rubia munjista* Roxb. as *R. cordifolia* L. var. *munjista* (Roxb.) Miq. syn. *R. cordifolia* sensu Hook. f. non L.

We have observed both pentamerous and

tetramerous flowers in the same specimen in a number of cases [*Wall. Cat.* 6208 C (CAL); *Brandis* 3457 (CAL); *F. Ludlow, G. Sherriff & J. H. Hicks* 20816 (CAL)] the former predominating. We have compared the microfilm photograph of the Linnean specimen with other specimens and found them similar in external characters. We have no doubt that they are synonymous. Dr. W. T. Stearn, Honorary Curator of the Linnean Society's botanical collections on examination of the type of *R. cordifolia* L. favoured us with his report for which we are so much grateful to him. He writes "I have now examined the specimen of *Rubia cordifolia* L. in the Linnean Herbarium sheat 131.7 representing a plant grown in the Upsala botanical garden. The three flowers available have each their parts in fours. Linneus described their flowers as '4-partiti'. This does not exclude the possibility that a specimen with more numerous flowers might have some pentamerous as well as the others tetramerous".

R. cordifolia Linn. var. **cordifolia**

Leaves: Veines 7, less frequently 5, rarely 9, very rarely 3, impressed; the surface of the leaf usually rough.

Flowering time: February-December. *Fruiting time:* March-January.

Distribution: India, Burma, Bhutan, Sikkim, Nepal, Tibet and Pakistan.

Herbarium specimens examined: Nefa: Kameng F.D.—*Panigrahi* 6914 (ASSAM & CAL); Bomdila to Rahung, *Rao* 7327 (ASSAM & CAL); Kalkatang to Morsing, *Panigrahi* 15701 (ASSAM); Aka hills, *Bor* 15124 (ASSAM). Manipur: Muku village, *Watt* 5057 (I.S.I.M.); Sirohifurer, *Watt* 5983 (I.S.I.M.). Nagaland: Mokakchung, *Burkill* s.n. (I.S.I.M.). Assam: Markasa, *Subba Rao* 28303 (ASSAM). West Bengal: Darjeeling, *Burkill* 25173 (CAL & I.S.I.M.); Phallut, *Burkill* 27683 (I.S.I.M), Kurseong, *Abdul Hakim* 205 k (DD); Darjeeling, *Maheshwari* 4992 (CAL). Bihar: Parasnath, *Watt* 9824 (I.S.I.M); Parasnath, *Srivastava* 21422 (LWG), *Chandra & Party* 33868, 36430, 36607 (LWG), *Roopchand* s.n. (CAL). Orissa: Durangabadi, ? 1375 (MH); Mahendragiri, *Fischer* 37 (CAL), *Saran & Party* 38841 (LWG); Mayurbhanj, ? s.n. (I.S. I.M.); Barhipani, *Panigrahi* 12659 (CAL); Mayurbhanj,? s.n. (DD). Uttar Pradesh: Mothranwala, *Dakshni* 5491 (BSD); Jakham ravines, *Malhotra* 1810 (BSD); Daurwala, *Malhotra* 19107 (BSD); Dehra Dun, *Rau* 12535 (BSD); Harbanswala Tea Estate, *Singh* 27484 (BSD); Dehra Dun, *Bharadwaja* 25733 (LWG), *Srivastava & Party* 45986 (LWG); Dehra Dun, *Awasthi* 14 (LWG); Chakrata, *Sahani* 26626 (DD); Dehra Dun, *Gupta* s.n. (BSI); *Balapur* s.n. (DD); Kumaon, *Rao* 4807 (BSD), *Singh & Party* 34 (LWG),? 19 (LWG), *King* s.n. (CAL); Bhimtal, *Rao* 4957 (BSD); Nainital, *Gill* 207 (LWG), *Mathur* s.n. (LWG), *Gupta* s.n. (DD); Garhwal, *Sarin & Rau* 3025 (BSD), *Bhattacharya* 24458 & 30909 (BSD), *Hooker* 38992 (I.S.I.M. & CAL), *Osmaston* 871 (DD); Mussoorie, *Rau* 1279 (BSD), *DA* s.n. (I.S.I.M.), *Jain* s.n. (LWG), *Puri* 10027, 10248 & 10819 (BSI), *Mackinnon* s.n. (CAL),? 440 (CAL), *Saxena* 1102 (DD); Almora *Srivastava & Party* 53645, 53744 & 53687 (LWG); Gorakhpur *Bharadwaja* s.n. (LWG), s.n. (LWG). Madhya Pradesh: Central Province, *Chatterji* 139 (I.S.I.M.); Kapildhara, *Maheshwari* 4203 (CAL). Kashmir: Jammu, *Abrol* 4042 (JAMMU); Katra, Jammu, *Abrol* 3547 (LWG); Kund, *Saran & Party* 9843 & 31846 (LWG); Ahrabal, *Aluwalhia* 2391 (JAMMU); Kashmir,? 3492 (JAMMU); Virnag, *Amin & Aslam* 2858 (LWG); Kulgam, *Amin & Aslam* 82817 (LWG); Firozpur, *Kaul & Party* s.n. (LWG); Doda, *Saran & Party* 30086 (LWG); Sonamarg, *Singh* 11552 (LWG); Kokarnag, *Kaul & Party* 23946 (LWG); Dachigam, *Kaul & Party* 23220 (LWG); Kashmir, *Saran & Party* s.n. (LWG); Achabal, *Kaul & Party* 23869 (LWG); Kashmir, *Saran & Party* s.n. (LWG); Dachigam, *Kaul & Party* 23869 (LWG); Srinagar, *Stoliczka* s.n. (CAL), *Gammie* s.n. (CAL); *Department of Botanical Survey, Govt. of India* 36145 (CAL); Satura, *Lembart* 194 (DD); Pahalgam to Chandanwari, *Wadhwa & Vohra* 196 (CAL). N. W. Himalaya: N. W. Himalaya, *Mackinnon* s.n. (CAL); Panwi, *Brandis* 3457 (CAL); Pange, *Brandis* s.n. (CAL). Punjab: Dalhausie, *Srivastava & Party* 60702 (LWG), Lahul, *Joeschpe* s.n. (CAL); Lahul, *Bor* 132 & 14993 (DD). Himachal Pradesh: Simla, *Watt* 10184 (CAL);? 33 (CAL), ? s.n. (CAL); Shothi, *Dogra & Party* 85901 (LWG); W. Goura, Bashahr, *Lace* 1080 (CAL). Gujrat: Surat, *A. Rahaman* 18 (DD). Maharastra: Purandhar, *Santapau* 1944 & 11432 (BLAT); Poona, ? 7620 & 27514 (BLAT); *College of Science, Poona* s.n. (I.S.I.M.); Singabad, Poona, *Watt* 5893 (I.S.I.M.); Napoklu, Poona, *Rao* 74872 (BSI); Ambowni, Poona, *Gammie* 15981 (BSI); Poona, *Babaji* s.n. (BSI); Mahabaleshwar, *Merchant* 463 a (BLAT); Bhor hills, Poona, s.n. (BSI); Mahabaleshwar, *Almida* 133 (BLAT), *Watt* 6781 (I.S.I.M.), *Bole* 125 (LWG); *Puri* 9203 & 16730 (BSI), *Rao* 62353 (BSI); ? s.n. (BSI), *Cooke* s.n. (BSI), *Kanodia* 87034 (BSI). *Ansari* 67522 (BSI), ? s.n. (CAL); Paud, Bombay, *Jain* 8828 (BSI): Bhimshankar, Bombay, *Puri* 8688 (BSI); Satara, Bombay, *Talbot* 4506 (BSI); Bombay, *Dalzell* s.n. (CAL). Mysore: S. Kanara, *Barber* 2382 (MH); N. Kanara, *Santapau* 18512 (BLAT), *Talbot* s.n. (BSI); Garsappa, N. Kanara, *Jain* 24566 A (BSI); Malemani, N. Kanara, *Jain* 12983 (BSI); Coorg, *Puri* 31789 & 45722 (BSI), *Rao* 74471 & 85476 (BSI), *Lawrie* 36 (DD); Agumbe, Shenoga, *Saldhana* CS 6068 (BLAT), Belgaun, *Ahuja* 47717 (BSI); Kemengandi, Mysore, *Badhwar* 4899 (JAMMU); Ballalarayandurga top, *Raghavan* 86961 (BSI); Agumbi-Venakabbi falls, *Mahajan* 34422 (BSI); West of Bhagamandala, *Rao* 95227 (BSI); Between Kundlipet and Shanivara, *Rao* 94601 (BSI); Yellapur, 1882, ? s.n. (BSI). Andhra Pradesh: Cumbum valley, *Subramanyam* 8075 (MH); Gudem (Vizag), *Wagh* 2107 (BLAT). Kerala: Trichur, *Sebastine* 15046 (MH); Kottayam, *Vivekananthan* 20397 (MH); Calicut, 19919 (MH). Madras: Dt. Nilgiri, Kotagiri, *Subramanyam* 1958 (MH & CAL); Coonoor, *Subramanyam* 2067 (MH & CAL); Nilgiri, *King* s.n. (CAL); *Clarke* 10575 B & 1128 B (CAL); Coonoor, *Prain* s.n. (CAL); Lower ghat road, *Munch* 2 (CAL); Nilgiri, *Schmidt* s.n. (CAL); Naduvatam, *Sethi, Negi & Raizada* 26196 (DD). Dt. Coimbatore, Annamalai, *Narayanaswami* 5425 (MH); Goddesal, ? 10788 (MH); Marudamalai, ? 14712 (MH); Karian Shola, *Joseph* 13827 (MH); Anagundy, *Subramanyam* 5563 (MH); Bailur, *Fischer* 598 (CAL); Coimbatore, ? s.n. (CAL); Coimbatore, *Narayanswami* s.n. (CAL); Shiruvani, *Subramanyam* 1519 (CAL), Shiruvani, *Henry* 1269 (BLAT); Thekkumalai, *Sebastine* 853 (CAL), Dt. Madurai, Pulney,? 16573 (MH); Vannathiporai, *Jacob* 17745 (MH); High way mountain, *Blatter & Hallberg* 895 (BLAT); Sirumalai, *Pallithanam* 105 (BLAT), S. Arcot, ? 1065 (MH); Near Melpel, *Subramanyam* 7462 (MH); Salem, *Bidie* s.n. (MH); Singampelti, *Sebastine* 5438 (MH); Naterikal, *Hooper & Ramaswami* 38530 (CAL); Ootacamund, *Barber* 5356 (MH), ? s.n. (CAL); Madras, *Rev. Aug. Saulires* 407 (CAL); Dumnakunda, *Narayanswami & Party* 208 (CAL); Madras; *Saran & Party* 39947 (LWG); Muthukulum, *Henry* 1132 (BLAT); Peninsulae Indiae Orientalis, *Wight* 1508 (CAL); Babab, *Meebold* 9715 (CAL). Burma: Lashoo, *Burkill* 22573 (I.S.I.M); Momion, *Anderson* s.n. (CAL); Southern Shan State, *Annandale* s.n. (CAL); Kachin hills, *Mokim* s.n. (CAL); Maymyo plateau, *Lace* 4332 (CAL), *Magkau* 249 (CAL); Upper Burma, *Clarke* C 14 (CAL); Mt. Victoria, *Mg. Gale & Chit Koka* (DD); Maymyo plateau, *Ba Pe* 1171 (DD); Thang Dong hill, *Wall. Cat.* 6209 B (CAL). Bhutan: Lao, Me-la-chu, N. E. Bhutan. *Ludlow, Sherriff & Hicks* 20816 (CAL); Choenpur et R. Chaya, *Wall. Cat.* 6209 A (CAL). Sikkim: Touglo, *Rhomoo* 289 (CAL); Sinchul, *Anderson* 683 (CAL); Luchung, *Gammie* 719 (CAL); Sungpoo, *King* 9120 (CAL); Sikkim, *Kurz* s.n. (CAL); Sikkim, *Rao* 1058 (CAL). Tibet: Sangpoo valley, *Walton* s.n. (CAL); Chumbi, *Dungpoo* s.n. (CAL); Tha Kao, *King* 462 (CAL); Chumba, *Clarke* 24309 B, C (CAL); Pangee, *Stoliczka* s.n. (CAL); Yatung, *Bor & Kiratram* (DD). Nepal: *Pande* 231 (DD); Central Nepal, *Srivastava* 21823 (LWG); Dindigal, *Wall. Cat.* 6209 E (CAL); Nepal, *Wall. Cat.* 6208 C (CAL), 6209 B (CAL); Bharko, *Agharkar* s.n. (CALC UNIV). West Pakistan: Kajan valley, Dt. Hazara, *Inayat* 19635 & 2483 (DD); Panjkora valley, *Gatacre* 17224 (CAL & DD); Kuram valley, *Aitchison* 256 & 628 (CAL), *Harsukh* 15348 (DD).

Note: The following specimens differ from others in membranous texture of the leaf but no other distinguishing character could be traced out for taxonomic distinction.

Maharastra: Bebington pt. road, *Mahajan* 24715 (BSI); Mahabaleshwar, *Mahajan* 24607 (BSI); Bhimshankar, *Vasavada* 6324 (BSI). Mysore: Mysore, *Ahuja* 65205 (BSI); Londa, *Gaikwad* 92/364/1 (BSI); Castle rock, *Gammie*, 15682 (BSI). Andhra Pradesh: Bison hill, *Barber* 5040 (MH). Madras: Panmachi valley, *Narayanswami* 19564 (MH); Dumnakunda, *Narayanswami* 652 (CAL).

R. cordifolia L. var. **cordifolia** f. **strigosa** Deb et Malick in Journ. Bomb. Nat. Hist. Soc. 63(3): 782, 1966.

This differs from the typical variety in having the leaves strigose on both surfaces, more so along the veins underneath and also in hispid stem and petiole.

Ta esiu Doom, Chumbi, 17.6.1884, *G. King* 482 A-C (A-Holotype, CAL; B & C-Isotype, CAL).

Paratype A - Jegaon to Poom, Kameng F. D. (NEFA), 21.5.1958, *G. Panigrahi* 16006 A & B (Paratypes A-CAL; B-ASSAM).

R. cordifolia L. var. **khasiana** Watt. Calc. Exhib. Cat. Pt. 2:54. 83-84 et Dict. Ec. Prodr. Ind. 6:1-B. 571. 1892. *R. khasiana* Kurz ex Maheshwari & Singh, Dict. Ec. Pl. Ind 138. 1965, nom. nud.

This differs from the typical variety in having 5, sometimes 3, rarely 7 veins not impressed, and in usually smooth surface of the leaf.

Type: This variety was originally described by Watt in Calc. Exhib. Cat. Pt. 2:54. 1883-84, wherein he writes "This is the richest in Madder dye-principle. It is occasionally met with in Sikkim but attains its greatest development eastward in the Khasia and Naga Hills. I repeatedly collected this form and compared it with the true cordifolia, thinking that it would probably be found to possess characters sufficient to justify its entire separation from that species if not its identification with *R. munjista* Roxb. But while arriving at the conclusion it was probably only a variety of *R. cordifolia* L. I satisfied myself as to its superior dye-yielding property".

It is evident from the above that Dr. Watt collected a large number of specimens of this variety, and kept in the place of his work, as 'Reporter on Economic Products' at the Indian Museum. Inspite of intensive search no herbarium specimen could be found in that herbarium with the varietal name written in Watt's own hand that could be treated as the type material. In the Industrial Section of the Indian Museum (I.S.I.M.) two gatherings *Watt* 4877 & 6158 are extant. These are named as *R. khasiana* Watt written in his own hand. *Watt* 4877 collected by him on 7.7.1894 from Khasia & Jaintea Hills does not bear any flower or fruit, while *Watt* 6158 (2 sheets) collected on 6.5.1895 from the Khasia Hills are complete with flowers and fruits. One of these sheets *Watt* 6158 A is designated here as the neotype.

Flowering time: March-December. *Fruiting time:* April-January.

Distribution: India, Sikkim, Nepal and E. Pakistan.

Herbarium specimens examined: Nefa: Kameng F. D., *Panigrahi* 6569 (ASSAM); Sissimi, *Panigrahi* 6100 (ASSAM); Perila hill, *Panigrahi* 16100 (ASSAM & CAL); Thengri to Rupa, *Panigrahi* 6595 (CAL); Jabrang to Perila, *Rao* 8144 (CAL); Subansiri F. D., Palim to Amji, *Subba Rao* 24919 (ASSAM); Petepool to Zimo, *Panigrahi* 18710 (ASSAM); Rupa, *Rao* 1320 (ASSAM); Hopali, *Rao* 1705 (ASSAM & CAL). Manipur: Sirohifurer, *Watt* 6464 (CAL). Assam: Khasia & Jaintea Hills-Shillong, *Kar* 294 (ASSAM), *Sarma* 21631 (ASSAM); Laitlying kot, *De* 16913 (ASSAM); Chandanmari, *Syam* 23030 (ASSAM); Beadon falls, 1913, *Kanjilal* 2426 (ASSAM); Shillong, *Panigrahi* 2883 (ASSAM & CAL); Cherrapunji, *Panigrahi* 4818 (ASSAM & CAL); Jowai Road, *Kanjilal* 8499 (ASSAM); Shillong, *Kanjilal* 288 (ASSAM); Shillong, *Deka* 21573 (ASSAM); Jorain-Jowai, *Halim* 28608 (ASSAM); Shillong, *S. Chaudhuri* 25475, 31812 (ASSAM), *Kar* 25363 (ASSAM); Pynursla, *Panigrahi* 2937 (ASSAM); Shillong, *Deka* 14089 (ASSAM), *Sarma* 10383 (ASSAM); *Bal* 656 (I.S.I.M.); Lyngkper, *Das* 35594 (I.S.I.M.); Khasia hill, *Watt* 6158 (I.S.I.M.); Khasia and Jaintea hills, *Watt* 4877 (I.S.I.M.), Maphlang, *Kapoor & Party* 69512 (LWG), *Nayer & Party* 50602 (LWG); Pynursla, *Panigrahi* 2937 (CAL); Khasia, ? 218 (CAL); Khasia, *Mann* s.n. (CAL), Numklum, ? s.n. (CAL); Jowai, *King* s.n. (CAL), Khasia, *Hooker & Thomson* s.n. (CAL); Kalapani, *Hooker & Thomson* s.n. (CAL); Khasia, *Oldham* s.n. (CAL); Khasia, ? s.n. (CAL); Khasia ? 437 (CAL); Cherrapunji, *Gallatly* 606 (CAL); Shillong, *Clarke* 44665 A (CAL); Pynursla, *Biswas* 4155 (CAL); Shillong, *Collet* 38 (CAL); Khasia hills, ? s.n. (CAL); Jowai, *Smythies* s.n. (CAL); Shillong, *Burkill & Banerji* 36 (CAL); Assam, *Bal* 356 (CAL); Khasia, *Mukerji* s.n. (CALC UNIV); Khasia, *Sen* s.n. (CALC UNIV); Shillong, *Ghosh* s.n. (CALC UNIV), *Basu* s.n. (CALC UNIV), *Sen* s.n. (CALC UNIV). E. Himalaya: North point, *Biswas* (LWG & DD). West Bengal: Darjeeling, *Badhwar* (JAMMU); Between Lebong and Badamtam, *Burkill* 34006 (I.S.I.M.); Darjeeling, *Srivastava & Sing* 63069 (LWG); Darjeeling, *Talbot* 3469 (CAL); Darjeeling, *Sengupta* 322 (CAL); Darjeeling, *Cousey* s.n. (CAL); Kalimpong, *Kinghorn* 32 (CAL); Kurseong, *Modder* 14 (CAL), Sandukphu, *Clarke* 35677 D (CAL); Darjeeling, *Gamble* 7065 (DD); Kurseong,? 54 D (DD) Birch hill, *Raizada* 18964 (DD); Darjeeling, *Majumdar* s.n. (CALC UNIV). E. Pakistan: Sylhet, *Wall. Cat.* 6209 C (CAL). Sikkim: Sureil, *Calder* 993 (CAL); Sikkim, *Rao* 174 (CAL); Forest north east of Gangtok, *Thothathri* 9466 (CAL); Sikkim, *Hooker* s.n. (CAL); Birhi to Birchingpong, *Anderson* 683 (CAL); Yaksum, *Anderson* s.n. (CAL), Sikkim, *Kurz* s.n. (CAL); Sikkim, *Kurz* s.n. (CAL); Tougloo, *Anderson* 683 (CAL); Sikkim, *King* s.n. (CAL); Peylong, *Bor* s.n. (DD); Sureil, *Gammie* s.n. (DD); Rungbee

Craib, 79 (CAL); Suriel, *Smith* 8 (CAL). NEPAL: Chatra, *Soil Conservation Res. Demonstration & Training Centre* 263 (CAL); Thama pass, *Itoh & Rajbhandari* 312 (CAL); Ething, *Banerjee* 718 (CAL); Nepal, *Wall. Cat*, 6208 A & 6209 (CAL). Nepal, *Agharkar* s.n. (CALC UNIV).

R. edgeworthii Hook. f. Fl. Brit. Ind. 3: 203. 1881; Koie &'Reching. in Symb. Afgh. 4: 1958 (Fig. 6). Scandent, pubescent *herb*; branches ascending; stem 8-ribbed, densely scabrid. *Leaves* simple, exstipulate, petiolate, membranous, 4 in whorl, 4-5.5 × 1.2-1.5 cm, lanceolate, acute or acuminate

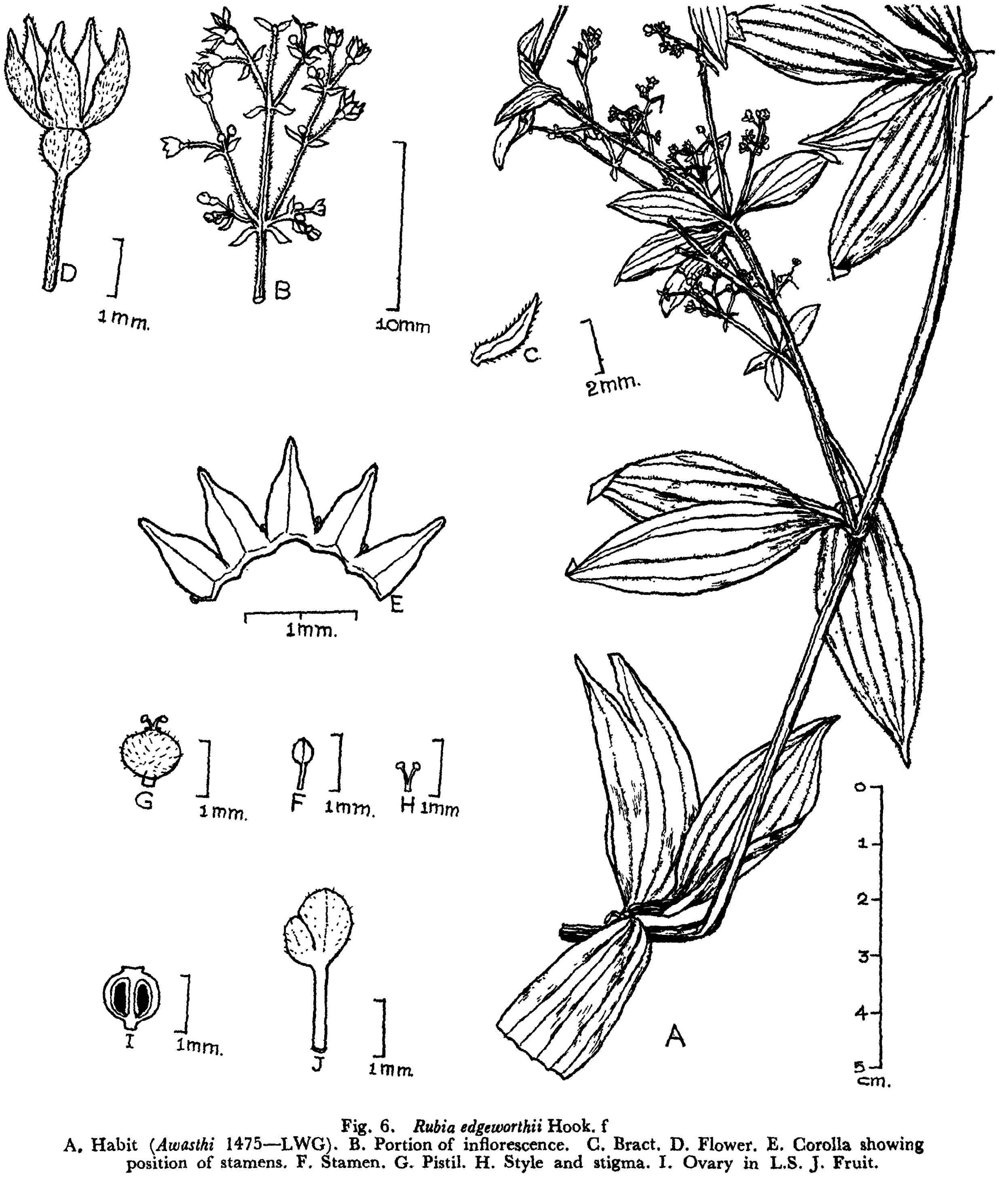

Fig. 6. *Rubia edgeworthii* Hook. f
A. Habit (*Awasthi* 1475—LWG). B. Portion of inflorescence. C. Bract. D. Flower. E. Corolla showing position of stamens. F. Stamen. G. Pistil. H. Style and stigma. I. Ovary in L.S. J. Fruit.

at the apex, attenuated at the base, entire at the margins, veins palmate, 3-5, converging towards the apex, deeply impressed on the upper surface; petiole short, .4-.5 cm long. *Inflorescence* axillary and terminal panicle of cymes; peduncles long, highly scabrid. *Flowers* bracteate, pedicellate, minute, 2-2.5 x 1.75-2 mm, regular, bisexual, pedicels 2-5 mm long scabrid; bracts in an opposite pair at each node, lowest pair foliaceous, .5-8 x .2-.3 cm, 1-3 veined, scabrid. *Calyx* globose, enclosing the ovary and adherent to it, scabrid, lobes absent. *Corolla* gamopetalous 2-2.5 x 1.75-2 mm, outer surface scabrid, tube very short, lobes 5, sometimes 4, lanceolate, .75-1 mm broad, acuminate at the apex. *Stamens* 5, sometimes 4, epipetalous, attached in a whorl at the base of the corolla; free portion of the filaments .5-.75 mm, longer than the anthers; anthers ellipsoid, 2-lobed, basifixed. *Pistil* bicarpellary, syncarpous; stigma globose, styles 2, united at the base, .5-.75 mm long. *Disk* annular, thin around the base of the style; ovary .75-1 x .75-1 mm, 2-celled, ovule one in each cell, attached to the base of the septum. *Fruit* glabrous.

Flowering time: September.

Distribution: West Himalaya.

Herbarium specimen examined: UTTAR PRADESH: Near Ganai (Almora to Berinag), 1350 m, 26.9.1950, *Awasthi* 1475 (LWG).

R. sikkimensis Kurz in Journ. Roy. As. Soc. Beng. 43 (2): 188. 1874; Hook. f. Fl. Brit. Ind. 3: 203. 1881 (Fig. 7).

Perennial, climbing *herb*, stout, scabrid, profusely branching; stem quadrangular, sharp, minutely scabrid, surface rough and scabrid. *Leaves* simple, sessile, 4 in whorl, equal in size, 5-13 x 2-5 cm, lanceolate, elliptic or elliptic-lanceolate, prickly at the margin, obtuse at the base, acute or acuminate at the apex, minutely scabrid on both surfaces, veins 3-5 palmate, deeply impressed. *Inflorescence* terminal and axillary panicle of cymes; peduncles long, almost stem-like. *Flowers* bracteate pedicellate, 3-4 x 3-4 mm; bracts 2-4, opposite, or in whorl, foliaceous, 3-9 mm long, sessile, lanceolate or elliptic, acute at the apex; pedicels 3-6 mm long, quadrangular, finely prickly. *Calyx* globose, enclosing the ovary and adherent to it, lobes absent. *Corolla* gamopetalous, 2.5-3 mm long, lobes 5, lanceolate, acuminate at the apex. *Stamens* 5, epipetalous, alternating the petals, free portion of the filament .5 mm long, anthers reniform, 2-lobed, dehiscing longitudinally, dorsifixed. Disk annular, much raised around the base of the style. *Pistil* bicarpellary, syncarpous; stigma globose; styles 2, free or partly united at the base, .5-.75 mm long; ovary ovoid, .75-1 x 1-1.25 mm, 2-celled, ovule one in each cell, attached to the base of the septum. *Fruit* 3-4 x 4-5 mm, globose by suppression of one carpel or didymous. *Seeds* suberect, albuminous; embryo with 2 leafy cotyledons and one straight axis.

Flowering time: October-January. *Fruiting time:* November-March.

Distribution: NEFA, Nagaland, Manipur, Assam, West Bengal (Darjeeling, Kurseong); Sikkim and Bhutan.

Type: Gunkabaree, Oct. 68, *S. Kurz* s.n. located in the herbarium (CAL) is designated here as the lectotype.

Herbarium specimens examined: NEFA: Lohit F.D.—Heyuliang to Douliang, *Rao* 10761 (ASSAM & CAL); Sovegodam—Breyi, *Rao* 10392 (ASSAM & CAL). Tirap F.D.—Kothong, *Deb* 26154 (ASSAM & CAL); Between Rotung and Kalek, *Burkill* 37565 (CAL & I.S.I.M.); Aka hills, *Bor* 16605 (ASSAM). NAGALAND: Naga hills, *D. Prain* s.n. (CAL); Dzulasee valley, *Bor* s.n. (DD). MANIPUR: Manipur, *Watt* 7315 (CAL & I.S.I.M.); Sirohifurer, *Watt* 5922 (CAL). ASSAM: *King* s.n. (CAL & I.S.I.M.); Duphla hills, *Lister* 169 (CAL), Aijal, *Godfrey* 625 (CAL); Lushai hills, *Mrs. Parry* s.n. (CAL), Mishmi hills, *Masters* (?) 1938 (CAL); Khasia, *Simons* s.n. (DD). WEST BENGAL: Between Lebong and Badamtam, *Burkill* 34008 (I.S.I.M.); Kurseong, *Kalkaprasad* s.n. (I.S.I.M.); Alipurduar, *Watt* s.n. (I.S.I.M.); Darjeeling, *Clarke* 10351, 13225 A & D (CAL); SIKKIM: Sikkim,? s.n. (JAMMU); Sikkim, *Prain* 96 (BSI); Sikkim, *King* s.n. (DD); Sikkim, *Griffith* 3066 (CAL); Sikkim, *King* s.n. (CAL); Sikkim,? 6557 (CAL); Sikkim, *Hooker* Rubia 2 (CAL); Silake, *Prain* s.n. (CAL); Rungbee, *King* s.n. (CAL); Mungpoo, *Gammie* s.n. (DD); Mungpoo, *Craib* 8 (CAL); Gunkabaree, *Kurz* s.n. (CAL); Riang 1902, *Prain* 4 (CAL). BHUTAN: *Range Officer, Jharbari range* 23460 (ASSAM); Dewangary hills, *Griffith* s.n. (CAL).

R. albicaulis Boiss. var. **stenophylla** Boiss. Fl. Or. 3: 19. 1876; Hook. f. Fl. Brit. Ind. 3: 204. 1881. *R. kotschyi* Boiss. [In Kotsch. Pl. Pers. Exs. Feb. 1845 &] Diagn. Pl. Or. Nov. 1 (6): 70. 1845 (Fig. 8).

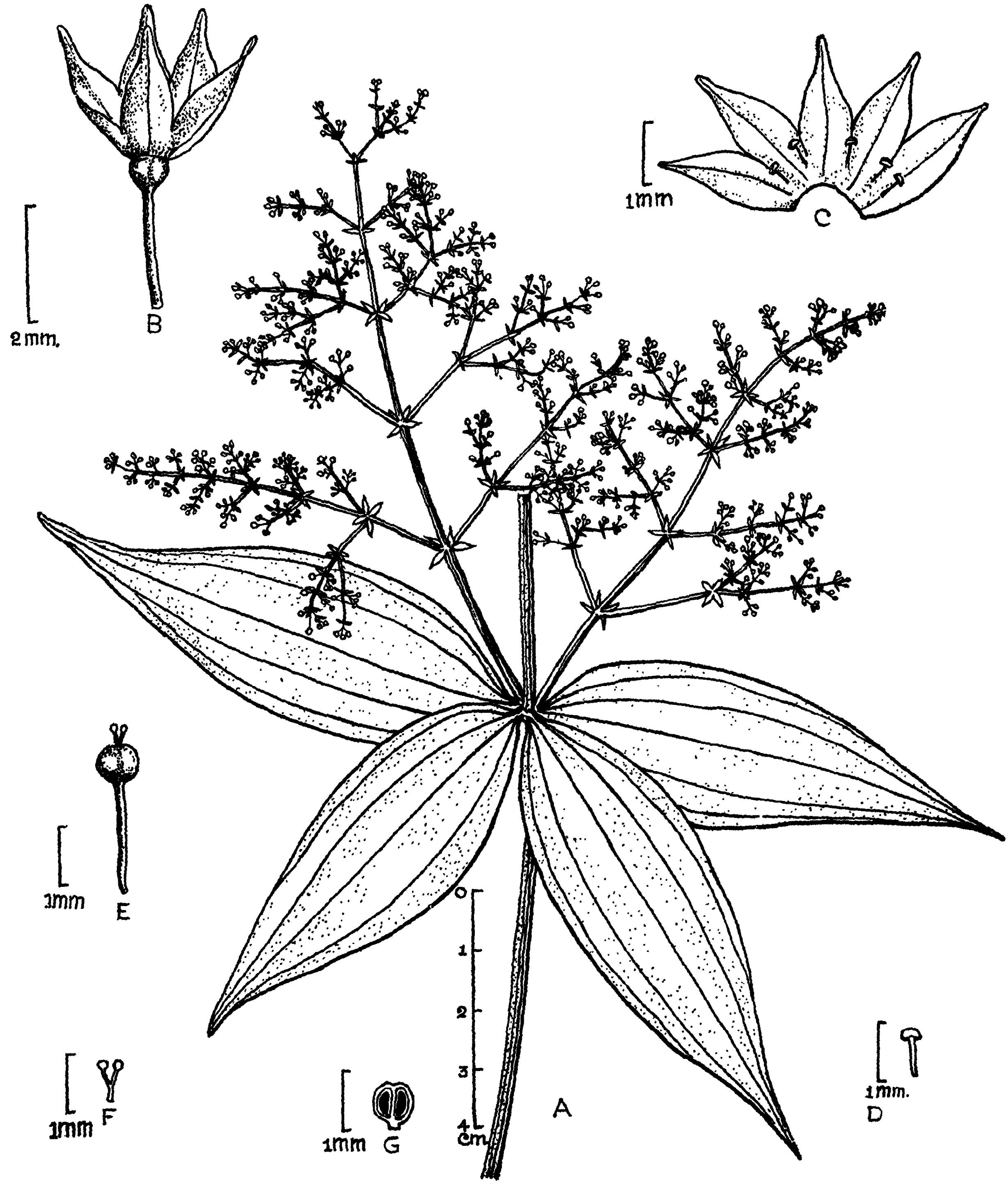

Fig. 7. *Rubia sikkimensis* Kurz
A. Habit (*King* s.n.). B. Flower. C. Corolla showing position of stamens. D. Stamen. E. Pistil.
F. Style and stigma. G. Ovary in L.S.

Erect *herb,* woody at the base; branches short, stem stout, whitish, quadrangular, angles rounded, smooth to highly scabrid. *Leaves* simple, 2 opposite or 4 in whorl, when 4, one pair larger than the other, 2.5-9 × .2-.6 cm, linear or linear-lanceolate, scabrid at the margin, acute at the apex, base attenuated, glabrous to highly scabrid, palmately veined, nerves 3, prominent, minutely scabrid. *Inflorescence* axillary and terminal panicle or cymes; peduncle short long, slender, quadrangular, smooth or scabrid. *Flowers* 2.5-7 x 2-4 mm, bracteate, pedicellate, bracts 2, linear-lanceolate; pedicels 2.5-3 mm long, pruinose. *Calyx* enclosing the ovary, adherent to it; lobes absent, smooth or scabrid. *Corolla* gamopetalous, 2-6 mm long, tube up to 3 mm long, lobes lanceolate, acute or mucronate at the apex. *Stamens* 5, sometimes 4, epipetalous, alternating the petals, free portion of the filaments .25-1 mm long, anthers at the throat of the corolla, ovoid, oblong or slightly reniform, .25-1 mm, dorsifixed. Disk thin annular around the base of the style. *Pistil* bicarpellary, syncarpous; stigma globose; styles 2, united to half the length, .75-1 mm long; ovary 75-1.5 x .5-1 mm, 2-celled, one ovule in each cell, attached to the base of the septum. *Fruit* 3-4 x 2.5-3.5 mm, globose by suppression of one carpel or didymous. *Seeds* suberect; embryo with 2 leafy cotyledons and one straight axis.

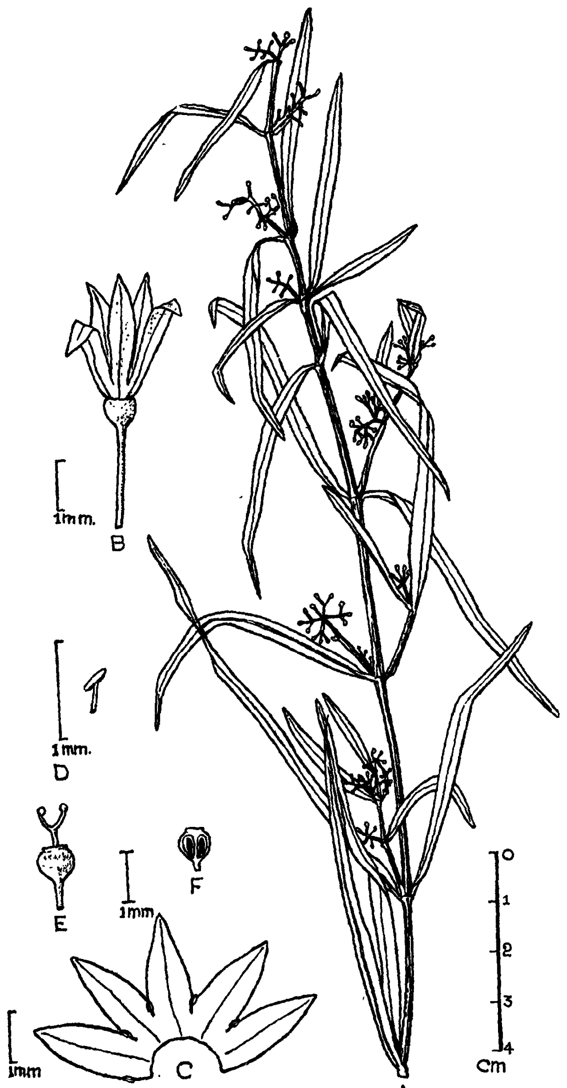

Fig. 8. *Rubia albicaulis* Boiss. var. *stenophylla* Boiss.
A. Habit. B. Flower. C. Corolla showing position of stamens. D. Stamen. E. Pistil. F. Ovary in L. S. (B-F. *Kotschy* 543).

Flowering time: May-July. *Fruiting time*: July-November.

Distribution: INDIA: Punjab (Kohat district) & Kashmir; Afghanistan.

Type: Schiras, 17.6.1842, *Kotschy* 543 located in the herbarium (CAL) is designated here as the lectotype.

Herbarium specimens examined: PUNJAB: Mir Khwell hill, Dist. Kohat, *Watt* s.n. (CAL). KASHMIR: Kashmir, *Falconer* 531 (CAL). AFGHANISTAN: Afghanistan, *Griffith* 3065 (CAL),? 748 (CAL); Sewara, *Williams* 9155 (DD).

R. albicaulis Boiss. var. **stenophylla** Boiss. f. **infundibularis** (Hemsl. & Lace) Deb et Malick in Journ. Bomb. Nat. Hist. Soc. 63(3): 783. 1966 (Fig. 9).

Basionym: *R. infundibularis* Hemsl. & Lace in Journ. Linn. Soc. 28: 324. 1891; Parker, For. Fl. Punjab 283. 1918; Koie & Reching. Symb. Afgh. 4: 188. 1958; Kitam. Fl. Afgh. 369. 1960.

Differs from the typical variety in having longer pedicels, bigger flowers, infundibuliform corolla and longer styles.

Distribution: West Pakistan, Afghanistan.

Type: Ziarat, Baluchistan, *J. H. Lace* 3945+3870 (CAL—Lectotype & I.S.I.M).

Herbarium specimens examined: WEST PAKISTAN: Hazara, *Inayat* 21832 (CAL); Kajan valley, *Inayat* 19636 (DD); Kajan, *Inayat* s.n. (CAL), Kurram valley, *Aitchison* 351, 629 (CAL), *Harsukh* 14685 (DD); Kanijuraum, Waziristan, *Harsukh* 15770 (CAL); Ziarat, *Lace* 3945+3870 (CAL & I.S.I.M.) and *Anderson* 49 (DD). AFGHANISTAN: Bhamaor, Chamba State, *Parker* s.n. (DD); Dhanni, *Stewart* 17346 (DD); Kurli, *Lace* 3870 (DD); Pergol, *Williams & Khan* s.n. (DD). N. W. FRONTIER: Samana range, *Hara* s. n. (CAL); Nathia, *Deane* s. n. (CAL.)

SPECIES UNDETERMINED

R. alata Wall. in Roxb. Fl. Ind. ed. Carey & Wall. 1: 384. 1820.

Type: Wall. Cat. 6208 (CAL). This does not deserve a specific status, nor can it be merged with *R. cordifolia* L. var. *cordifolia*. Probably it is distinct infraspecific taxon.

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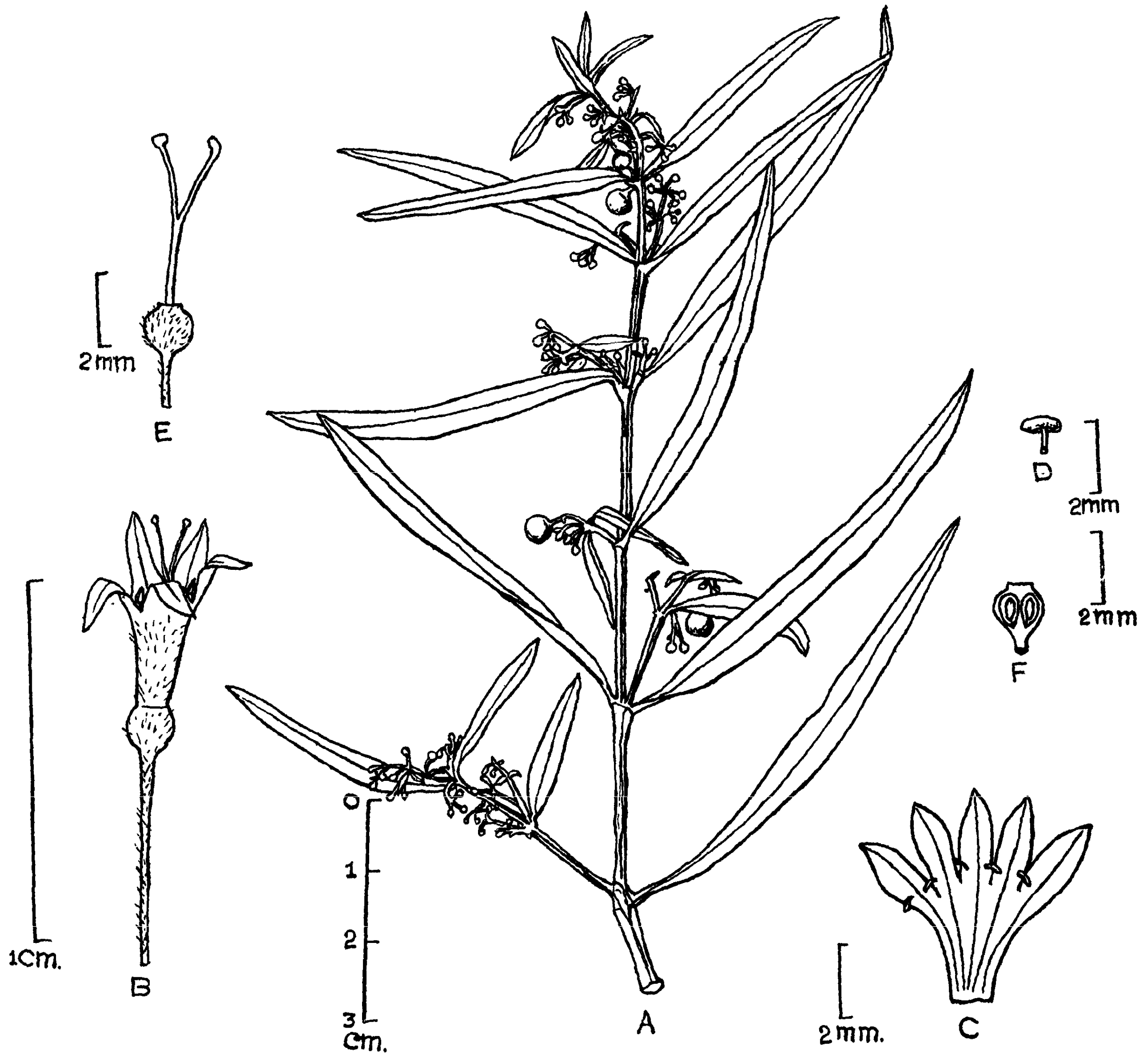

Fig. 9. *Rubia albicaulis* Boiss. var. *stenophylla* Boiss. f. *infundibularis* (Hemsl. & Lace) Deb et Malick
A. Habit. B. Flower. C. Corolla showing position of stamens. D. Stamen. E. Pistil. F. Ovary in L. S.
(A. *Deane* s.n., B-F—*Lace* 3945+3870).

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